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RESOURCE GUIDE: HEATING SYSTEMS FOR SUPERINSULATED HOUSES

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SAFETY MUST BE THE PRIMARY CONCERN

When superinsulation is properly practiced, the cost of auxiliary heat is typically very low: superinsulated houses have been built in our coldest climates that use less than $100 a year in supplemental space heat.

These low heating costs are achieved by a combination of energy-conserving techniques: the use of higher levels of insulation, the installation of an airtight air-vapor barrier, and the use of a separate ventilation system with heat recovery.

But, these new practices demand a change in thinking when it comes to the choice and sizing of heating systems.

First, and most importantly, the use of an airtight building shell and a controlled ventilation system makes the choice of a compatible, safe heating system a critical element in the design of a superinsulated house. Unfortunately, many professionals and homebuyers continue to overlook this issue and assume that all types of heating systems are appropriate.

Second, the heating system can be much smaller than in a conventional house, and this reduced cost helps make superinsulation a very economic approach.

THE CRITICAL DIFFERENCE

The airtight nature of the superinsulated house makes it very different from conventional housing: during the heating season, ventilation is provided through a heat recovery ventilation system, not by air leakage through cracks and leaks in the building's shell. (During warmer weather, windows can provide needed ventilation for both conventional and superinsulated houses.)

Thus, great caution must be exercised whenever a combustion heating system is considered. In a conventional house, combustion air for these systems is drawn from inside the house. In a superinsulated house, this combustion air must be drawn from the outdoors.

The controlled ventilation system in a superinsulated house should never be expected to provide this needed combustion air alone; it's quite possible that not enough combustion air will be available unless windows and doors are opened.

COMBUSTION SOURCES MUST BE COMPLETELY ISOLATED

The key to providing a clean, safe indoor environment is: If any combustion devices are used in an airtight house, these devices must be completely isolated from the indoor air.

This means indoor air won't be drawn for combustion. Instead, outdoor air is directly ducted into the combustion device, and combustion byproducts are also directly ducted to the outdoors. This forms a sealed combustion loop that never involves the air indoors (Figure 1).

In recent years, manufacturers have designed such heating systems. And, new, small sealed combustion "mini-furnaces" are now available for superinsulated houses. (See product listings later in this publication.) These furnaces can provide a safe way to burn natural gas, propane or bottled gas for the small amount of space heat that will be required.

Unfortunately, similar closed-combustion systems for hot water heating are not yet available. If you opt for a combustion system to heat domestic water, you should get professional assistance to correctly isolate the heater.

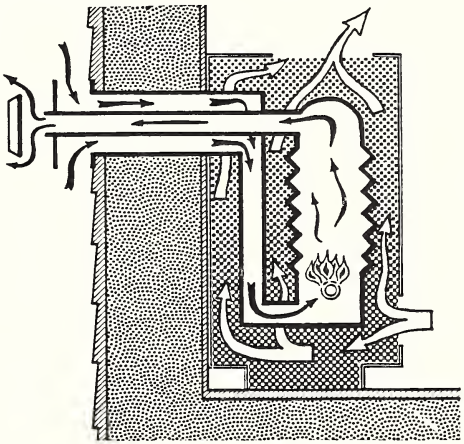

Figure 1: *Mini-furnaces for superinsulated houses feature a closed combustion cycle - outside air for combustion is directly ducted into the furnace. The combustion air can be pre-warmed by the outgoing exhaust gases.*

APPROPRIATE HEATING SYSTEMS FOR SUPERINSULATION

Because the heating requirements are so minimal, the heating system can be quite small - 10,000 - 30,000 BTUs per hour is adequate for most house sizes.

Another feature of heating a superinsulated house is that a single source of heat (such as a single, through-the-wall heater) can provide sufficient heat for the entire house because the ventilation system can adequately mix the heated air with cooler air. The ventilation ductwork does not move air from the heating source; instead, the air flows caused by the ventilation system can make for fairly uniform heat distribution without a discreet heating ductwork system.

Thus, central forced-air systems are typically not used in most cold-climate superinsulated houses; the small heating load makes these systems inappropriate from a cost standpoint unless the house is very large.

Note that it is best not to interconnect your ventilation system with your heating system. In a well-built superinsulated house, the ventilation system will be frequently used, while the auxiliary heating system is rarely used.

ELECTRIC OR GAS HEAT?

Electric heat and appliances make sense from a safety, cost and flexibility standpoint for superinsulated houses. The new mini-furnaces now make natural gas, propane or bottled gas a reasonable choice, as well.

Electric baseboard is probably the most popular option because of its low cost and the fact that it can be exactly sized and zoned.

Other options include portable electric heaters, radiant electric panels, or radiant electric ceiling heat.

From an installation cost standpoint, there may be little difference in cost between electric baseboard and one small gas mini-furnace. The choice should be made depending on one's utility situation, location and other variables. (In rural areas where electric service isn't always predictable, propane heat may be desirable, for instance.)

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WHY WOOD HEAT MAKES LITTLE SENSE

The "warmth" of an open hearth makes the fireplace a popular item for homebuyers in many parts of the country. And, the use of woodstoves has become synonymous with "lower utility bills" for many Americans living in conventional houses.

However, at the present state of the art, neither fireplaces or woodstoves are wise choices for heating superinsulated houses.

First, why go through the trouble of installing an airtight vapor barrier if you're also going to install a big hole (a chimney) in the house? Second, fireplaces are notorious heat losers; installing a fireplace in a superinsulated house must be considered to be merely an aesthetic choice: it could actually increase heating costs!

With woodstoves, it hardly makes sense to haul and split wood to save under $100 a year. So little wood will be used for heat in a superinsulated house that the extra effort is hardly worth it. And, because it's not exactly easy to make a woodstove provide "just a little heat," it's not unlikely that overheating could occur and windows will need to be opened to cool the place down!

But, the most critical reason why conventional fireplaces and woodstoves cannot be considered to be truly safe is because of the airtight nature of the house and because a balanced ventilation system is installed.

A fireplace or woodstove can draw combustion air from the house at a considerable rate, overtaxing the ability of the ventilation system to provide it. This can cause negative air pressure in the house (Figure 2). This negative air pressure can cause backdrafting down the chimney, bringing deadly combustion gases including carbon monoxide into the living space (Figure 3).

(This backdrafting, sometimes fatal, is reported every year in conventional houses because of the pressure differences between gas or oil chimneys and fireplace chimneys.)

Even though it is possible to directly duct outside combustion air to fireplaces, the combustion process could still allow pollutants to escape into the indoor air. And, an unwary occupant could inadvertantly allow backdrafting to occur by simply opening the fireplace doors or other similar actions.

At least one state is discussing the possibility of mandating that woodstove manufacturers provide stoves that allow combustion air to be directly ducted to them. At present, some designers are putting a combustion air supply duct in the vicinity of the woodstove, but not directly ducting the air to the stove. Preliminary testing has indicated that this method does not prevent the buildup of combustion pollution indoors. The combustion process must be completely isolated from the indoor air.

Building and real estate professionals note that woodstoves and fireplaces are often demanded by potential buyers. Unfortunately, many builders give in to their clients without realizing that they could be creating a potentially deadly situation.

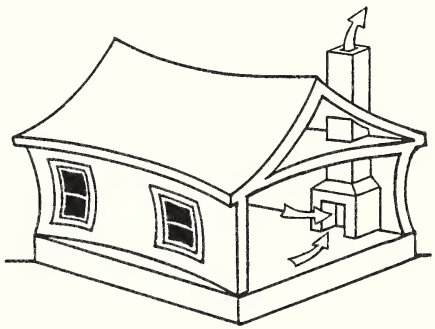

Figure 2: *The draft of a fireplace can negatively pressurize the house.*

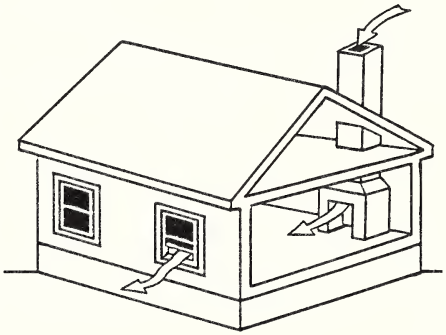

Figure 3: *Backdrafting can cause dangerous combustion gases to enter the indoor air.*

SEALED COMBUSTION MINI-FURNACES

Manufacturers haven't yet adopted a distinct term to describe sealed combustion furnaces. Unfortunately, sealed combustion units are usually grouped with other conventional furnaces under the term "direct vent" furnaces. To avoid any confusion over terms, carefully scan product literature to be sure you are getting a sealed combustion unit that uses no room air for the combustion process; all combustion air must directly enter the device from the outdoors.

The following product listings include only one type of furnace: sealed-combustion, "direct-vent" mini-furnaces.

Because these mini-furnaces use outdoor air for combustion, many are designed to be placed on an exterior wall to minimize the length of the intake and exhaust ducting. Some of the newer mini-furnaces are even available with optional ducting arrangements that accommodate walls up to 20 inches thick! (This may be another indication of the growing popularity of superinsulation.)

Another desirable feature in these furnaces is the use of intermittent spark ignition devices. Intermittent ignition allows a pilot light to remain unlit until the furnace is actually used, reducing the waste of gas.

Reference to these products does not imply recommendation or endorsement by the National Center for Appropriate Technology to the exclusion of other products that may be suitable.

Dearborn Stove Company
c/o Addison Products Company
215 North Talbot St.
Addison, MI 49220
517/547-6131

The Dearborn sealed combustion wall furnaces have a Btu input range of from 14,000 to 65,000 Btu's. Models are available with intermittent spark ignition.

Empire Stove Company
918 Freeburg Avenue
Belleville, IL 62222
618/233-7420

The Empire line of sealed combustion wall furnaces has a Btu input range of from 10,000 to 60,000 Btu's. Empire has models that are available with intermittent spark ignition.

Heil-Quaker Corporation
647 Thompson Lane
Nashville, TN 37204
615/244-0450

Heil-Quaker makes sealed combustion wall furnaces that have a Btu input range of from 20,000 to 50,000 Btu's. Two models feature intermittent spark ignition.

Locke Stove Company
114 West 11th Street
Kansas City, MO 64105
816/421-1650

The Locke line of small, sealed combustion wall furnaces has a Btu input that ranges from 10,000 to 90,000 Btu's.

Louisville Tin and Stove Company
737 S. 13th St.
Louisville, KY 40201
502/589-5380

The three Louisville sealed combustion furnaces have a Btu inputs of 15,000, 25,000, and 35,000.

Perfection Products Company
Division of Schwank, Inc.
P.O. Box 40
Waynesboro, GA 30830
404/554-2101

The Perfection models have a Btu input range from 11,000 to 33,000.

Suburban Manufacturing Company
Box 399
Dayton, TN 37321
615/775-2131

The Suburban line of sealed combustion furnaces has a Btu input range of from 20,000 to 65,000. Suburban models are available with intermittent spark ignition.

Williams Furnace Company
225 Acacia St.
Colton, CA 92324
714/825-0993

The Williams line of sealed combustion furnaces has a Btu input range of from 14,000 to 65,000. Several Williams models are available with intermittent spark ignition.

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